THURSDAY, JUNE 15, 1893.

APPLIED CHEMISTRY.

Dictionary of Applied Chemistry. By Prof. T. E. Thorpe, F.R.S., assisted by eminent contributors. Vol. iii., completing the work. (London: Longmans, 1893.)

THE completion of Dr. Thorpe's Dictionary, upon which both men of science and of practice may with truth congratulate him and his contributors, opens out the question how far such a work, however well done, can or cannot supply the needs at once of the layman, of the scientific man, and of the manufacturer. Perhaps this standard may be too high a one to apply to any single work, and yet I think that in many respects these three volumes will be found satisfactorily to fulfil the above requirements. That in some instances this cannot be said to be the case is not only not to be wondered at but almost to be expected, when we remember the extent of the ground covered, the complexity of the questions considered, and, above all, the difficulty which persons not actually engaged in the various industries experience in obtaining the latest details of new and improved methods and processes. In looking through this volume one is struck with the care which the editor has taken to carry out the condition that the articles on special manufactures ought to be written by scientific men who are themselves engaged in conducting the industry, rather than by those who can only look on those questions from outside. To give examples of this is easy. Take the article on Borax (Sodium Borate) written by Mr. E. L. Fleming. The reader will at once see, by comparing this with any descriptions of the process of preparing borax given in the text-books, that this article is full of data which have hitherto been either ignored or incorrectly given. Again "Sugar," written by Messrs. Newlands, extending over twenty-two pages, is a typical case of descriptions of processes written by persons well acquainted with the details of the operations and able to describe them clearly, and, what is important, care has been taken to illustrate the article by excellent figures of plant. Closely connected with this subject, and also admirably treated by Mr. Heron, a practical authority, to whom we likewise owe an exhaustive article on saccharimetry not to be equalled in any work of the kind, is a description of starch manufacture, in which the newest processes are described and the construction of the most recent apparatus well shown. Then the articles, "Pottery" and "Porcelain," written by Mr. Burton, of Wedgwoods, is another example of processes described by one who knows what he is writing about. Another remarkable instance of the same thing is that of the article, "Phosphorus," by Dr. J. B. Readman. Hitherto the detail of phosphorus manufacture has been a *mare clausum* to the scientific world—and so well have the secrets of the trade been kept, that in no treatise, whether purely scientific or otherwise, have the particulars of the production of phosphorus been hitherto made known. Now for the first time we have, from the pen of one who was himself engaged in the industry, a complete description not only of the methods adopted for making both white and red phosphorus, but likewise the manufacturing details as to yield, which are invaluable. It seems that the explanation given in the books as to the preparation of this important element has been altogether wrong. It has been generally supposed that only so much sulphuric acid is added to the bone-phosphate as will form the acid phosphate, $CaH_4(PO_4)_2$, and that this yields metaphosphate, $Ca(PO_3)_2$, when heated to redness, so that when this latter is distilled with charcoal only two-thirds of the phosphorus are reduced, and one-third remains behind as tricalcium phosphate. This view turns out to be wholly incorrect. In practice enough sulphuric acid is added to convert all the lime present into sulphate, so that it is metaphosphoric acid, (HPO_3), and not calcium metaphosphate, which on distillation with charcoal gives phosphorus, and the yield amounts to about 68 per cent. of the theoretical.

In a notice like the present it is not possible to do more than to run through a few of the most interesting articles in alphabetical order. I take first that on Oils, by Mr. A. H. Allen, of Sheffield, an authority on this somewhat difficult subject. No less than thirty-eight pages are devoted to the description of fixed oils and fats, especially with respect to their classification and identification by analysis, in which the newest and most improved methods are given. I fail, however, to find the name of Chevreul mentioned, to whom chemistry owes the first and still classical research on fats. Then I next take "Oxalic Acid and the Oxalates," a short article by the editor, whose valuable contributions, be it here said, form no inconsiderable fraction of the total 1058 pages. He has not stated the interesting fact quoted in the report published by Drs. Schunck, Smith, and myself in 1862, which, although ancient history, is still true, that from two pounds of sawdust no less than one pound of crystallised oxalic acid is obtained by Dale's process. Nor do I find any mention of manganese oxalate, which is now a marketable product, and is used as a drying agent for oils, and has the advantage over the other "driers," inasmuch as they colour the oil, whereas manganese oxalate can be used so as to yield an almost colourless drying oil. Omissions such as these are, as I have said, not to be wondered at, and I quote them with the object of pointing out that this Dictionary, admirable as it is, cannot replace such sources of information on applied chemistry as the journal of the Society of Chemical Industry, but that it must rather be considered as an introduction to such a mine of wealth as this journal—which I may call a child of my own—contains, and to add, as I feel bound to do, that some of the writers would have done well to refer more fully to its twelve volumes before completing their articles.

Next comes "Oxygen," written by Dr. L. T. Thorne, of Brin's Oxygen Company, and here I may notice a misprint on p. 83—and say that such misprints are singularly rare throughout the book, reflecting great credit on both editor and printer—which has puzzled me. In the description of Robbin's process a reference is given P.J. [2] 5. 436. I looked in vain through the *Journal für Praktische Chemie*, and only after some time discovered that P.J. should be Ph. (the *Pharmaceutical Journal*). A more important error remains to be noticed in this paragraph. How a mixture of 3 mols. of barium chloride and 1 mol of potassium bichromate, on treatment with sulphuric acid *in the cold*, can yield oxygen I could not understand but, on looking up the original paper, I find that for barium chloride, barium peroxide should have been printed. Here CrO_3 and H_2O_2 mutually decompose to Cr_2O_3 and water, whilst pure oxygen derived from both sources comes off. This interesting reaction is not a new one, as it was used by Brodie in 1851, and adverted to in a lecture by Faraday at the Royal Institution; nor does it appear to be capable of producing oxygen at a sufficiently low cost to be of practical value. Of course, Dr. Thorne gives an excellent description of Brin's well-known process by which oxygen is now manufactured on a large scale, but I do not find any statement of a process which bids fair to compete with Brin, viz. Fanta's improvement on Tessie du Motay's reaction, by which oxygen is evolved from manganate of soda by the action of steam. He does indeed refer to Du Motay, and gives the cost of oxygen prepared by his process at from £3 to £4 per 1000 cubic feet, whereas that by the Brin process is given as from 3*s*. to 7*s*. I cannot help thinking that this proportional cost is incorrect, as I know that Fanta's process, the patent of which appears to have superseded Bowman's, is now in practical operation at the Bradford Gas Works, and this would scarcely be the case if the cost were as great as Dr. Thorne states.

That pure oxygen can now be produced at so low a figure as 3*s*. per 1000 cubic feet is a great fact, and induces the hope that we may ere long see it at 1*s*. per 1000. In that case the use of oxygen to heighten the temperature of combustion would become general, especially for welding and riveting of steel and iron. Even now its uses are spreading, not only for the oxyhydrogen light, but for purifying coal-gas. The addition of from 0·5 to 1·0 per cent. of oxygen to crude coal-gas renders its purification more complete and easy, as thus the sulphur compounds are reduced to 12 grains per 1000 cubic feet, and lime alone suffices as a purifying agent. Moreover, the luminosity of the gas is said to be increased. This application of oxygen is on its trial at certain gasworks, but it has to be shown how far this plan of adding oxygen acts more satisfactorily than the much cheaper one of the addition of air, in spite of the small loss in illuminating power which the presence of atmospheric nitrogen entails.

Next I turn to "Paper," by Mr. E. J. Bevan, a short but good article, in which I find a description, in which one misses some illustrations, of the method of recovering the soda used in the preparation of the esparto and other fibres used in making paper. No example of the applications of science to the working up of waste products is more striking than this. Before the introduction of the Rivers Pollution Act of 1876, no paper-maker thought of recovering his soda—all the liquors went to pollute the streams on which the works are situated. Now most paper-mills recover their soda, and save thereby from 80 to 85 per cent. of this costly article, whilst at the same time they have diminished the nuisance which they caused to their neighbours on the stream below them. It is high time that every user of soda for disintegrating or bleaching fibres of all kinds should be prohibited from thus fouling the water, and that the application of the "best practicable means" clause were rigidly enforced by all local authorities interested in improving the quality of the water of our rivers.

The article on "Petroleum," by Mr. Boverton Redwood, is another instance of information given by a high authority. It extends over forty pages, is up to date, and abundantly illustrated. "Photography," by Prof. J. M. Thomson, gives a clear and concise account of the chief processes of the application of photography to lithography and mechanical printing, now becoming more and more perfect, and the article concludes by giving a list of the more important works on the subject.

The two longest articles in the volume are, as might be guessed, Sodium and its compounds, occupying 93 pages and Sulphuric Acid and its relatives, taking up 84. The manufacture of sodium is one of the most remarkable advances of the time; not long ago it could only be bought by the ounce, and at an exorbitantly high price, now an order for 100 tons will be executed by the Aluminium Company, of Oldbury, and the price is only a few shillings a pound. Castner's process for making sodium is fully described, but the excellent illustrations are only of historic interest, inasmuch as the process which they indicate has lately been superseded by a more economic one. The article on Sodium Chloride is of a most complete and trustworthy character, and has been written by Mr. J. I. Watts, of Messrs. Brunner, Mond, and Co., where he has had ample opportunities of making himself master of every detail of the processes he describes. Sulphur and Sulphuric Acid are interesting articles by Dr. Alder-Wright, who adds to his scientific knowledge practical experience of the manufacture. I cannot pretend to discuss the merits—which are great—of these articles. I will only remark that they contain information up to date, and I am glad to see that Dr. Wright has consulted the *Journal of Chemical Industry*, and has given the readers of the Dictionary an opportunity of becoming acquainted with Dr. Hurter's researches on the chemistry of the leaden chamber, published in that journal.

The important article "Water" is contributed, as it should be, by Prof. Percy Frankland. With regard to this able article, extending over fifty-five pages, I have to remark that the author, whilst giving an excellent account of the chemistry of water, seems to have forgotten that he is writing an article in a dictionary of applied and not in one of pure chemistry. Why, for example, should two pages of valuable space be taken up by a long table of the tension of aqueous vapour? Nor is it clear that so many analyses of mineral waters need be quoted, no less than fifteen pages being taken up by tabular matter. On the other hand, greater prominence might well have been given to more technical details of the various methods of water purification. Here I think that the author might have given some extracts from the volumes of the Chemical Industry Society with profit, where, as he well knows, much new and important information is to be found. There is not a single diagram or illustration in this article showing the arrangements proposed for filtration or other means of purifying water; thus, whilst the author refers to the "Stanhope" purifier, he gives no drawing to explain its construction. Prof. Tilden's important experiments on the corrosive action of water on brass and copper are not referred to, a classical subject originally investigated by Davy in 1824, and reported upon by him to the Admiralty of that day. Nor is the paper of Mr. V. C. Driffield on the practical details on the use of carbonate of soda for softening water for boilers, important to every manufacturer, mentioned. Points such as these, which I might multiply, are needed by the practical man, and ought to have found a place in such a work.

Last, but not least, I will refer to the article on "Wine," written by Prof. Thorpe, which is of interest as giving a luminous account of vintage and vinification, and of the chemical changes which the vegetable acids present in the grape undergo during the process of wine-making. I miss, however, reference to the Pasteurisation of wine and to the classical researches of the great French chemist on the diseases of wine. Perhaps, however, the editor has rightly conceived that such matters, however important, do not quite come within the scope of "applied chemistry," and that the omission is intentional. I should have liked to refer to many other matters of interest with which this volume teems, but I have compassion on your space. Again I congratulate all concerned in the production of this Dictionary, which will, I feel sure, long continue as the standard work in our language.

H. E. ROSCOE.

A POPULAR ATLAS.

The Universal Atlas. Containing 117 Pages of Maps and an Alphabetical Index of 125,000 Names. (London, Paris, and Melbourne. Published for the Atlas Publishing Company, Limited, by Cassell and Company, Limited, 1893.)

THIS Atlas, published in a strong cloth binding at 30*s.* net, is certainly unique in the British Market, and in its serial form it has already obtained a deservedly wide circulation.

There is no kind of publication of which the British public is so ignorant as a map, and the fact that few purchasers can tell the difference between a good map and a bad one has produced its natural effects. One of these is that the reviews of atlases in literary journals and the daily press are usually characterised by a tone of forced praise, and rarely go beyond free quotation from the publisher's preface or prospectus. It is more difficult to review a map than a book on account of the immense amount of concentrated information it contains, and even those who are competent for the task are often inclined to shrink from the close study and careful comparison which are necessary. The quality and price of the *Universal Atlas* are so unusual that we feel justified in examining it with some care, and in offering a few suggestions for its further improvement.

The work is published for an unknown company by Messrs. Cassell. There is no hint as to who designed the atlas or drew the maps or engraved the plates, or produced the book. The only indication borne by each sheet is "Printed in Leipzig." German map-printers are good, but there are atlases made in London and Edinburgh which are much better than this; unfortunately they are also much more expensive. One effect of the present publication will, we hope, be to call forth native work designed so as to hold its own in cost as well as quality with that of Germany. Meanwhile the *Universal Atlas* deserves success as a pioneer. We strongly object, however, to the practice—not unknown to some British mapmakers—of issuing the work of trained scientific men without acknowledgment; and of republishing earlier maps without mentioning the fact. If Messrs. Cassell had bound up with the Atlas the "history," which they print as a separate advertisement, and if the name of the printer to whom the creditable appearance of the work is due appeared upon it, we would have almost unqualified praise to bestow on them. As it is, however, we must plainly say that they have not done justice either to the memory of Andree, who prepared the original maps, or to the skill of Mr. W. J. Turner, who so admirably translated them, or even to the enterprise of Mr. H. O. Arnold-Forster, the chairman and presumably the promoter of the publishing company. We regret also that Messrs. Cassell did not entrust the printing to some firm in this country; although the first cost might have been greater, we do not believe that the profit would ultimately prove less.

Not knowing who the editor of the English edition of the Atlas is, we must blame the publishers for failing to adjust the balance of representation to English requirements. Germany is treated with undue detail; the United Kingdom is not adequately shown. Large parts of Germany are given on the scale of 1:870,000; no part of Great Britain is shown larger than 1:1,000,000. No enlargements of English industrial regions, or the environs of British towns appear, although Andree's German edition contains two on the scale 1:750,000. Many of the Continental sheets, on the other hand, are crowded with valuable insets giving details of special districts. The Colonies are, on the whole, very well shown; Canada has a fair amount of space, Africa is lavishly treated, and India is clearly mapped, although the scale is comparatively small. But Queensland, New Zealand and Tasmania, British Guiana, and all the small Asiatic colonies, have been slighted. It is interesting, however, to find Fiji, Samoa, and the West Indies given on a scale making each island show as a visible disc, which displays some little topographical detail. We would suggest that the neglected parts of the empire, some of the more important South American States (the delineation of which is far too small), and the central part of the United States, should have more space devoted to them. Room might be provided by suppressing the large scale map of Alsace-Lorraine, and the rather blurred map of Hungary on p. 51 (also Bohemia, p. 52), which have the scale of 1:2,500,000, and show scarcely more detail than does the general map of Austria-Hungary, pp. 47, 48, which is on the very similar scale of 1:2,750,000.

It is undesirable to enter into a minute criticism of individual maps, for the best workers cannot avoid occasional mistakes, and the most diligent revision has hard work to keep pace with the unceasing changes of railways, populations, and boundaries. We may notice, however, that Aberdeen, Bolton, Cardiff, Croydon, Preston, and Reims have now populations exceeding 100,000, and should be designated by the special sign set apart for towns of the first magnitude. Ross and Cromarty have ceased to exist as separate counties, and the care bestowed on colouring and lettering the detached fragments